

Motivation: a biobehavioural approach

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Introduction and perspective

WHY THIS BOOK?

1

This book is concerned with the analysis of motivated behaviour from a biological perspective. Although some psychology students may find biological topics less to their personal tastes than material that is specifically human-oriented with a social emphasis, I hope that they may be pleasantly surprised by the material in this book. It is possible to link these topics and it has been attempted in a third year undergraduate Motivation course which I taught from such a perspective at the University of British Columbia, Canada, for over 30 years. The encouraging reactions of these students during lectures and in their course ratings has motivated me to share some of this material with you.

Texts by Colgan (1989) and Toates (1986) have focused on some issues in animal motivation which form the corpus of the present book, but these earlier books were relatively short and very selective in their coverage. Although this book adopts a conceptual framework similar to that developed in the Colgan and Toates books, it is less restrictive and thus appropriate for a broader based Motivation course. Most of the recent texts on motivation (e.g. Franken, 1994; Mook, 1996; Petri, 1996) are expansive, eclectic and almost encyclopaedic in their coverage of topics. Although the framework of this book is derived from the animal motivation tradition, it can also be used to analyse relevant issues in human motivation. Thus this work sits between the larger omnibus motivation texts and the smaller ones that focus specifically on animal motivation.

Almost every text devotes a chapter, or at least a section of one to the history of motivation, and then lists various definitions of this concept by different theorists. I will not revisit this territory because it has been amply explored in many excellent sources. If you wish to visit this area, see the texts by deCatanzaro (1999, pp.1–18), Franken (1994,

pp. 4–14), Geen (1995, pp. 1–19), Mook (1996, pp. 25–53) and Toates (1986, pp. 21–34). Unfortunately, definitions of motivation abound and are linked to the particular theory or model espoused by the author. ‘The way that the term “motivation” is used depends upon the purpose of one’s explanation, which in turn will reflect the model of behaviour that one employs’ (Toates, 1986, p. 17). These differences in the scholars’ theoretical perspectives not only influence their definition of motivation but also the domain of research and focus. Such considerations provoked Petri (1996, p. 22) to surmise that ‘because motivation cuts across so many different subfields of psychology, its study often seems to be disjointed, with the various theories having little relationship’.

Petri (1996) dealt with the dilemma of ‘disjointed eclecticism’ by adopting an approach that focused on determining ‘how differing motivating factors (biological, behavioural, cognitive) interact to produce behaviour’. This appears to be a reasonable approach and has been adopted in other recent texts in the field (deCatanzaro, 1999; Franken, 1994; Mook, 1996). However, an examination of the content of such books reveal an eclecticism in which the relationship among chapters is not always apparent. Petri (1996, p. 22) admitted that the content of his book was eclectic but suggested that the multi-factor approach provided a unifying theme. Although the recent textbook by deCatanzaro presents material from the multi-factor approach in its inclusion of evolutionary, physiological, developmental and social perspectives, its organisation and coverage are different from that of the present work.

In the present book I have attempted to avoid the problems of ‘disjointed eclecticism’ by organising the material in a systematic manner. Each chapter will be devoted to individual systems underlying specific motivational states that result in motivated acts such as mating, parental care, feeding, drinking, exploring, affiliating, withdrawing, attacking and the like. Within each chapter as well as among the chapters I will examine the similarities as well as interactions between various systems classed as motivational. In the final chapter I will discuss whether there are any general principles of motivation that may be discerned from the analysis of these individual motivational systems. This organisation and perspective is congruent with the multi-factor approach and you will see many instances of its application throughout the book.

MOTIVATION AND LEVELS OF EXPLANATION

Toates (1980; 1986) articulated the premise that motivational factors are responsible for the organism’s goal-directed commerce with biologically

important incentives. This premise may provoke you to ask what is meant by the terms 'motivation', 'goal-directedness' and 'incentives'? I will answer these questions in the course of this chapter. Although experts in the field argue heatedly about definitions of these concepts and some even wonder whether such concepts are necessary (Kennedy, 1992), I believe that there is general agreement about the involvement of motivational analysis in causal explanations of action. When we ask why a person or an animal engages in a specific set of actions, we are asking about their motivation (Mook, 1996, p. 4). Motivation has to do with the reasons underlying behaviour. These reasons can be analysed on at least two levels. We can ask *why* an individual exhibits certain activities and also *how* these activities came about. The explanation of behaviour in terms of motivational mechanisms at the former level is referred to as *ultimate causation*, whilst explanation at the latter level is referred to as *proximate causation*.

Explanations of why some behaviour is exhibited implies a historical basis for the action. There may be some good reasons for its occurrence and it may have been adaptive for an animal or person to act that way. However, this adaptationist viewpoint has its critics (e.g. Gould & Lewontin, 1979). For those who favour adaptation-oriented explanations, an analysis of behaviour in terms of ultimate causation is also regarded as a *functional* explanation. What function was served by the occurrence of that specific behaviour? It is assumed that there was something to be gained by behaving in that way. Animals or humans who did not show such reactions would be unlikely to adapt as well as those who manifest this characteristic. Questions about the ultimate function of behaviour patterns in terms of adaptedness have been raised by those who are influenced by an evolutionary orientation (e.g. Alcock, 1998). Such theorists contend that the conditions of our pre-history and history influence motivational dispositions that in turn, are selected for through anatomical, physiological as well as psychological mechanisms. They assume that natural selection acted as a designing agent in shaping the proximate physiological and psychological control mechanisms responsible for behaviour. These mechanisms provide an explanation concerning *how* certain activities occur.

Many books on motivation focus mainly on proximate mechanisms at the physiological level (e.g. Mogenson, 1977; Pfaff, 1982; Stellar & Stellar, 1985) or at the psychological and social levels (e.g. McClelland, 1987; Mook, 1996; Weiner, 1980, 1985). The latter analyse the influence of motivational states or disposition on behavioural and cognitive manifestations. Most authors make passing and cursory reference to the

importance of evolutionary factors on motivation and they seldom go beyond paying obligatory homage. They devote scant attention to any discussion on why motivated activities have emerged in their present form and seldom consider their implications on the selection and shaping of proximate mechanisms. Such questions and considerations have been raised by Buss (1999), Cosmides & Tooby (1995) as well as Daly & Wilson (1983). These authors present an alternative approach in which the principles of natural selection serve as a starting point for the development of models of the adaptive problems that the species of interest had to solve. Considerations of ultimate causation will be evident throughout the motivational analysis of behaviour in this book.

An example: analysis of taste preferences

I present an example that will illustrate the utility of the type of motivational analysis advocated in this book. Most of us enjoy snacks even though we may not feel hungry. What are favourite snack foods? Candy or chocolate bars? Ice cream ? Chips sprinkled with lots of salt? Salted peanuts? When we eat, foods stimulate taste receptors on the tongue and the basic taste qualities are sweet, salty, sour or bitter. It is a common observation that most animals and humans show a positive preference of foods conveying specific basic taste qualities. There seems to be a universal 'liking' of food substances that taste sweet or salty. Specific receptors on the tongue are coded to respond to sodium or sugars in foods that are ingested. When the 'sweet' or 'salty' receptor is stimulated, we exhibit behaviour that indicates a preference for foods that contain chemicals that stimulate these receptors. We show continued ingestion of such foods and experience a positive psychological affective state or hedonic experience. In fact, the Greek word for pleasure, *hedone*, relates to the Greek for honey, *hedus*. Booth (1994) proposed that there is a pleasing character of the activity of satisfying a desire for a sweet food. The same may be said about our liking of slightly salty foods. What are the reasons for this reaction?

The taste affect is 'hard-wired' since it is present before we, as infants, have had any experience of the consequences of ingesting sweet substances such as sugar. This inborn affect of taste explains why we use terms involving taste to express value. We often comment that a person has a 'sweet disposition' or that another person has a 'bitter outlook on life' (Bartoshuk, 1989). These are examples where we have borrowed the affective tone of the taste quality and applied it to some other affective situation. Biological factors may be invoked to provide a reasonable

explanation. Taste is the sense that is tuned in to nutrients. A salty taste is characteristic of sodium whereas a sweet taste is characteristic of biologically useful sugars. In contrast, the bitter taste is characteristic of a variety of poisons, whilst the sour taste is associated with highly acid and sometimes rotting foods.

A motivational analysis of the reasons for why we seek and ingest quantities of sweets and salty snacks considers both *ultimate* as well as *proximate* causal factors. Evolutionary factors are responsible for the selection of physiological and psychological mechanisms that are responsible for our reactions to sweet and salty tastes. This consideration would spur us to inquire into the nature of human salt and sweet preference mechanisms and whether they mesh with our physiological requirements for salts and sugar and what the opportunities were for procuring them during our pre-history (Cosmides & Tooby, 1995). I will elaborate on this analysis in greater detail in Chapter 5.

MOTIVATIONAL PROCESSES AND PROBLEMS OF REDUCTIONISM

Earlier, I had referred to Toates's (1980, 1986) notion that motivation involves goal-oriented commerce with incentives that are usually of biological significance. When an organism is motivated to behave in a certain way, this behaviour is terminated when a goal is achieved. In that respect, motivated behaviour may be characterised as guided by its consequences and is related to some end point linked with biological requirements of the organism. McFarland (1989) argued that although motivated acts appear to be directed by goals, these acts are not necessarily specifically directed toward some internal representation of that goal. The motivational state persists until the goal has been attained. The success of this motivated act results from either a change in the organism's relation to the external world, a change in its internal state or both. I will return to this discussion on purposive behaviour and goal-direction in the concluding chapter.

Motivational processes are inferred from properties of behaviour that appear to terminate a sequence of goal-oriented events but cannot be observed directly. Thus, motivation is a dispositional variable or concept that is inferred from behaviour. Whenever we analyse motivation or motivational processes, we accomplish this by studying motivated behaviour. Although physiological interventions may influence the state of the organism, the main focus of our observations is still the behaving organism. For example, no one has ever seen *thirst*. We can

observe how long a person has gone without water and then assess how much he drinks, or how hard she will work or pay to get some water. But we can never see thirst itself. Even if we probe inside the person's head, we could see only brain cells, not motives. The physiologist adopting a reductionistic approach seeks an explanation of behaviour in terms of neural activity and must have some idea of about the properties of the behaviour he or she is trying to explain.

In 1951, Tinbergen, a pioneer in ethology, a field dealing with the biology of behaviour, pointed out the problem in bridging the great gap between what nerve cells do and how animals behave. Tinbergen (1954, p. 115) stated that 'to try to arrive at an understanding of the causation of behaviour by jumping to the level of the neurone, or of simple neurone systems is extremely harmful . . .'. It is harmful because 'the machinery is so complex that looking at the millions of parts that go to make it up will only confuse and make it more difficult to see how the the whole works' (M.S. Dawkins, 1986, p. 98). Even more critical is the fact that 'the complete wiring diagram of the nervous system would not constitute understanding of how behaviour works. Real understanding will only come from distillation of general principles at a higher level' (R. Dawkins, 1976, p. 7). Following Tinbergen, these ethologists adopted the view that the wrong way to determine behaviour mechanisms is to try to work from the bottom up. Behaviour must be approached at its own level rather than simply as a projection of physiology (Halliday & Slater, 1983, p. 4). Thus the physiologist must be guided by considerations of the manner in which thirst is manifested.

ORGANISATION OF THIS BOOK

As I mentioned earlier, the chapters in this book are organised around specific forms of motivated behaviour. In objective terms, such behaviour involves molar acts that regularly consummate or terminate a recurring behaviour sequence related to some dispositional state. Acts such as mating, caregiving, feeding, drinking, sleeping, 'dreaming', exploring and withdrawing from and attacking aversive stimuli are consummatory in structure. The functional significance of these acts is quite apparent. The appropriate execution of these acts maintains the individual's fitness and involves vital biological, psychological and social processes. The concept of *fitness* will be discussed in detail when I deal with the analysis of mating or reproductive behaviour in the next chapter.

Each of these motivated acts will be analysed in the subsequent chapters from the perspective of ultimate and proximate causal factors.

Ultimate causal factors involve the process of natural selection that is responsible for the retention or elimination of specific characteristics over successive generations. This process results in the selection of genes guiding the developmental programmes constructing mechanisms to produce behaviour. Thus behaviour is an effect that is an outcome of a causal system that reflects the effects of proximate mechanisms. As a result of the effects of natural selection that shape these proximate mechanisms, the resultant behaviour correlates to some extent with the organism's biological fitness. In general, the evolutionary function of the brain is to process information in ways that lead to adaptive behaviour.

The success of an organism depends upon the existence of a set of interacting motivational causal systems that enables it to deal with the major problems of survival and gene propagation. Colgan (1989) grouped these causal systems into various domains or areas. The primary domain concerns *reproduction* and entails successful courtship and parental care. The second grouping concerns *nutrition and fluid balance* whilst the third deals with *personal care* which involves sleeping and care of the body surface. The fourth category involves *agonistic reactions* and corresponding motivational states of fear and aggression are manifested in behaviours such as fighting and fleeing. Colgan's grouping of causal motivational systems is logical and makes much sense. I have adopted the basic structure of Colgan's taxonomy of motivational causal systems but have omitted discussion of the personal care system. Instead, I have extended the behavioural categories in some domains as well as added an additional category or major grouping dealing with social motives.

A preview of the forthcoming chapters

I have arranged the sequence of material in the subsequent chapters in terms of specific motivated activities. They belong to one of the causal systems in Colgan's (1989) list of basic functions as well as one concerning social motivation. The most essential property of life is reproduction and from this premise it follows that the primary motivational causal system is concerned with this domain. Chapter 2 outlines various aspects of sexual behaviour that range from evolutionary to physiological to psychological to social and cultural factors. In this chapter I examine how biological characteristics of the sexual reproductive system are manifested in male-female behavioural differences in animals and humans. In addition, I consider current thoughts concerning the fitness interests of males and females and the reasons for their mating tactics. In this context, I examine recent material on cross-cultural studies on human

mate choice. I also analyse recent research on the ontogeny of male-female differences from both the physiological and social perspective.

In most sexually reproducing species, it is not enough that males and females engage in successful mating encounters that result in the production of viable offspring. The fitness interests of these animals are enhanced by parental caregiving to the offspring, usually by the mother. Chapter 3 deals with a topic that has not received the coverage and treatment which it deserves in other texts on motivation. In this chapter I consider the importance of this behaviour from an evolutionary perspective and examine examples from mammalian and avian species. I also analyse research on human parental care from this perspective. In addition to the analysis of parental behaviour at the level of ultimate causal mechanisms, the influence of proximate causal mechanisms at the physiological and psychological levels will also be examined.

Chapters 4 through to 6 deal with aspects of the grouping of motivational causal systems dealing with nutritional and fluid balance. In Chapter 4 I examine the concept of homeostasis and relate it to properties of the feeding system. Most reviews on feeding tend to regard this behaviour as a mere endpoint for the evaluation of the effectiveness of various physiological manipulations. Although material from this position is covered, I consider a synthesis of the physiological, psychological and ecological aspects of the feeding system. In this synthesis I examine the interplay of energy/repletion cycles and homeostatic mechanisms as they relate to the role of environmental/psychological factors in the regulation of feeding. I also examine two types of eating dysfunctions prevalent in some humans, that of obesity and anorexia. In this analysis I deal with social, psychological as well as physiological variables together with their interplay but in addition, I consider possible evolutionary factors that may influence the dispositional tendencies of some individuals to fall prey to one or other of these dysfunctions.

Chapter 5 deals with the other important aspect of feeding, the selection or choice of nutrients. Most of the existing books on motivation have focused mainly on factors that initiate, maintain and terminate feeding, concentrating on consumption and rarely dealing with food choice or selection from an array of possibilities. The issue of food selection and its causes is an important one because the integrity of the system is dependent upon the appropriate selection of mechanisms. I examine how factors operating at the physiological, psychological and social/cultural levels influence our choice of foods. The ultimate causal or evolutionary mechanisms responsible for the manifestation of these specific proximate mechanisms is brought into the analysis. This is of

particular interest when we study the strong influence of culture and cuisine on food preferences in humans.

Chapter 6 concerns fluid regulation within the body arising from the interaction of internal and external factors. Drinking may be viewed as a behavioural mechanism for either maintaining or restoring the water balance of the body. Solute within the body tissues and deviations from an ideal solute ratio are detected by specific receptors in the nervous system which in turn activate behaviour that directs the organism to seek fluids. Physiological mechanisms also regulate the internal water balance by acting upon physiological mechanisms that prevent further loss of water through internal conservation. In addition to these factors, fluid intake can be instigated when the solute/solution ratio remains unchanged but there is a loss of absolute volume in body fluids, such as may occur following severe blood loss, or loss of liquid arising from diarrhoea or vomiting. Drinking, however, is also influenced by factors other than that of the internal state of the animal. Palatability of the liquid and its effects on the hedonic state of the animal is an important factor affecting both intake and choice. Cues from the external environment also affect the motivational state of the animal and results in enhanced intake among animals whose water balance is normal.

All animals have the tendency during a portion of their waking moments to explore their environment and engage in stimulus-seeking activities. Chapter 7 will deal with this type of motivated activity, one that is provoked by the interaction of the state of the nervous system and the stimuli that are impinging upon its sense organs. Behaviour of this sort involves responses toward novelty and is believed to represent a possible information-gathering mechanism essential to the animal's adaptive adjustment to its spatial environment. Unlike the other motivated activities, exploratory behaviour is believed by some motivation theorists to be independent of drive-reduction and reinforcement. Because of this consideration, Green (1987, p. 318) has argued that such behaviour 'can be seen to lie completely outside the traditional approach to the motivation of behaviour'. In this chapter I will present data and theory that suggests the differences in mechanisms may not be as great as Green suggested. In addition, I will discuss the relationship between exploration and fear as well as Zuckerman's (1994) integration of biological and physiological considerations to the analysis of sensation seeking tendencies in humans.

When animals are exposed to aversive stimuli, they are likely to display either escape or attack behaviour. Both types of responses to the source of aversiveness have adaptive significance. Specific escape mech-

anisms have evolved for dealing with physical danger. One of the simplest is the withdrawal reflex that removes the organism from damaging stimuli. For example, taste receptors that respond to bitter or very sour substances elicit a spitting reflex as protection against those chemicals which ingested would have dangerous consequences. More complex situations that elicit such protective and defensive reactions will be elaborated in Chapter 8. The analysis implicates psychological mechanisms that enable animals to anticipate threatening and damaging events and thereby avoid contact with them. Animals will also react to aversive stimuli with attack behaviour. In many respects withdrawing and attacking behaviour can be analysed in a manner similar to that applied to the other consummatory activities. In this chapter I indicate the value in analysing the behavioural effects of aversive stimuli in terms of responses elicited by them. This contrasts with the learning framework that focuses more on the fact that animals acquire responses that are instrumental in removing themselves from the source of aversion. Such responses become strengthened and integrated as a result of repeated exposures in the test situation and are regarded as acts developed through learning. In contrast to this interpretation, animals may be pre-programmed through natural selection to acquire specific responses because they are elicited by aversive stimuli. The instrumental aspect of the situation may be fortuitous. From the perspective of proximate analysis, the instrumental aspect of the situation focuses on the function of the behaviour whilst the elicited aspect focuses on the causation of the response.

Of course there is much more to the analysis of responses to aversive events than elicited reactions. Motivational and emotional states are induced in such situations and they are presumed to mediate the direction which behaviour takes. Psychological states such as fear or aggression are the mechanisms that determine whether an animal expresses either 'flight' or 'fight' in its reactions to stimuli in its environment. The context in which the animal encounters these stimuli as well as its previous history with them influences the 'interpretation' that it applies to the situation. Physiological and psychological experiments on these states and the circumstances of their instatement will be presented in Chapter 8. The chapter will also analyse a source of aversion that does not involve pain, namely that of frustrative non-reward. In this analysis we will encounter Gray's (1987) model that demonstrates the functional similarity of mechanisms underlying fear and frustration. A discussion of aggression from both an evolutionary as well as the physiological/psychological perspective will end this chapter along with the issue of homicide and recent evolutionary psychological explanations.

Some behaviours that reflect the manifestation of social motives such as attachment and altruism will be discussed in Chapter 9. There is considerable literature analysing these motives from the perspective of social and developmental psychology as reflected in the recent texts on human motivation mentioned in the beginning of the present chapter. In this short chapter I will revisit this territory but focus on the biological foundations of these behaviours. During the 1990s there has been interest in applying both proximate and ultimate causal analysis of these phenomena. Although much of the research has been concerned with animals, representative studies on humans arising from theories coming from animal studies are more prevalent. This chapter will indicate that there is a consummatory element to these motivated activities just as there is to those that are more directly concerned with the integrity of the individual system. However, in concert with the theories derived from the social and developmental psychology framework, I discuss the extent to which processes and mechanisms of attachment and altruism among humans may reflect variables of a different order than those of the other species.

The final chapter of this book is concerned with the commonalities, differences, as well as interactions of the motivated activities that have been studied in the previous chapters. Motivated behaviour patterns are the products of an intimate interaction between the organism and its environment. In the analyses of individual motivational systems covered in each chapter I have attempted to relate physiological with psychological events not by reducing or explaining behaviour in physiological concepts but by indicating the reciprocal interaction of physiological processes and response patterns. Thus biological events are an essential part of psychological events but are no more basic to behaviour than are other factors such as the characteristics of the stimulus object or the organism's past interactions with a stimulus object.

In Chapter 10, I will indicate how some of the material of the preceding chapters are related. For example, it is obvious that feeding and drinking are interrelated. When an animal ingests food, it also takes in water that appears to anticipate later food intake. Meals influence the timing and amount of drinking because food introduces solute into the blood and shifts water from body fluids into the gut. However, feeding can be inhibited by variables that affect the other consummatory acts. If an animal suffers a water deficit as a result of water deprivation, it will voluntarily limit its food intake. Of course, when the animal is allowed access to water, its food intake will be increased. Also feeding is momentarily inhibited when an animal is fed in a novel environment and during a different period of time. The animal requires a period of

adjustment to the new feeding conditions before it is able to exhibit compensatory feeding behaviour. The novel stimuli in the test situations elicit stimulus seeking or exploratory behaviours that interfere with feeding. The animal eats once it habituates to the stimuli in the test apparatus and the stimuli are no longer novel to it. In other words, the animal no longer displays neophobic reactions. A similar treatment will be applied to the interaction of other motivational processes.

In the concluding part of Chapter 10, I consider recent developments which resulted in a re-conceptualisation of rewards and their effects on motivated behaviour. The recent work of Berridge (1996) has provoked a re-examination of traditional views concerning reward and its relation to brain systems. His research suggests that reward contains distinguishable psychological components consisting of an affective component (liking) and an appetitive or incentive component (wanting). These can be manipulated and measured separately, and Berridge's research also indicated liking and wanting processes arise from vastly distributed neural systems. His work suggests a way in which affective or hedonic factors (*pleasure*) and motivation may be instantiated by the interplay among neural systems. The manifestation of motivated behaviour may thus depend upon the separate but equally important contributions of *affective* and *incentive* processes.

SUMMARY

Motivation is a dispositional variable or concept that is inferred from behaviour. Motivation concerns the reasons underlying behaviour, and can be analysed on at least two levels. We can ask *why* an individual exhibits certain activities (ultimate causation) and also ask *how* these activities came about (proximate causation). When an organism is motivated to behave in a certain way, behaviour is terminated when a goal is achieved. Such behaviour is guided by its consequences and is related to some end point linked with the biological requirements of the organism.

The first nine chapters in this book are organised around specific forms of motivated behaviour, which are analysed from the perspective of ultimate and proximate causal factors. The material in these chapters also indicate how the manifestation of motivated behaviour is dependent upon the separate but equally important contributions of *affective* and *incentive* processes. The final chapter deals with the relationship of material of the preceding chapters, and suggests how affective factors and motivation may be instantiated by the interplay among neural systems.